REMARKS/ARGUMENTS

Reconsideration of this application in light of the above amendments and following comments is courteously solicited.

The invention as claimed in previously amended claim 1 is directed to a copper alloy consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities, which has a hardness Hv of 80.2 to 103.1, wherein a proportion of an alpha phase is 90 vol% or more, and wherein an apparent content B' of zinc in said copper alloy is in the range of from 34 to 39 wt%, said apparent content B' of zinc being expressed by the following expression:

$$B' = [(B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4) / (A + B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4)] \times 100$$

wherein A denotes the content (wt%) of copper and B denotes the content (wt%) of zinc, t_1, t_2, t_3 and t_4 denoting zinc equivalents of tin, silicon, nickel and iron, respectively ($t_1 = 2.0$, $t_2 = 10.0$, $t_3 = -1.3$, $t_4 = 0.9$), and q_1, q_2, q_3 and q_4 denoting the contents (wt%) of tin, silicon, nickel and iron, respectively.

The invention as claimed in currently amended claim 12 is directed to a copper alloy consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities, which has a hardness Hv of 80.2 to 103.1, wherein an

apparent content B' of zinc in said copper alloy is in the range of from 34 to 39 wt%, said apparent content B' of zinc being expressed by the following expression:

$$B' = [(B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4) / (A + B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4)] \times 100$$

wherein A denotes the content (wt%) of copper and B denotes the content (wt%) of zinc, t_1, t_2, t_3 and t_4 denoting zinc equivalents of tin, silicon, nickel and iron, respectively ($t_1 = 2.0$, $t_2 = 10.0$, $t_3 = -1.3$, $t_4 = 0.9$), and q_1, q_2, q_3 and q_4 denoting the contents (wt%) of tin, silicon, nickel and iron, respectively.

Such copper alloys have an excellent stress corrosion cracking resistance and an excellent dezincing resistance while maintaining excellent characteristics of conventional brasses.

Such copper alloys can be produced by adding appropriate amounts of tin (Sn) and silicon (Si) (and at least one of lead (Pb), bismuth (Bi), nickel (Ni), phosphorus (P) and iron (Fe), if necessary) to a conventional brass material and by carrying out a heat treatment on appropriate conditions to control the structure of the alloy.

Specifically, such copper alloys can be produced by a method for producing a copper alloy, the method comprising the steps of: preparing raw materials of a copper alloy consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities, the apparent content B' of zinc in the copper alloy being in the range of from 34 to 39 wt%; casting the raw materials to form an ingot; hot working said ingot; cold or hot working the hot worked ingot; annealing the

cold or hot worked ingot at a temperature of 300 to 600°C for two minutes to five hours; and cooling the annealed ingot at a cooling rate of 0.2 to 10°C/sec.

Furthermore, the apparent content B' of zinc in the copper alloy is a function of the contents of elements contained in the copper alloy. Therefore, the apparent content B' is a parameter for limiting the ranges of the contents of the elements to define a copper alloy as claimed in claims 1 and 11-13. That is, the apparent content B' is a parameter for defining the ranges of the contents of the elements. Therefore, it is clear that the apparent content B' of zinc in the copper alloy is not the discovery of a general formula if it covers a composition described in the prior art.

Claims 1 and 11-13 were rejected under 35 U.S.C. §103 as being unpatentable over US 2002/0015657 to Dong.

Dong discloses a copper-base alloy comprising 57 to 60 wt% of copper, 0.3 to 3 wt% of tin, 0.02 to 1.5 wt% of silicon, 0.5 to 3 wt% of lead, and any one of 0.02 to 0.2 wt% of phosphorus, 0.01 to 2 wt% of iron and 0.01 to 2 wt% of nickel. Dong also discloses a method for producing the above-described copper-base alloy by casting the raw materials of the alloy to form a billet, holding the billet at 800°C for 30 minutes, and then, hot extruding the billet into a bar. The copper-base alloy thus obtained can have a stable and excellent dezincing resistance.

However, Dong fails to disclose or suggest any copper alloys consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities, the apparent

content B' of zinc in the copper alloy being in the range of from 34 to 39 wt%, and the copper alloy having a hardness Hv of 80.2 to 103.1.

That is, Dong fails to disclose or suggest any copper alloys having the claimed composition and the claimed hardness.

Dong also fails to disclose or suggest any methods for producing a copper alloy, comprising the steps of casting the raw materials of the alloy to form an ingot; hot working said ingot; cold or hot working the hot worked ingot; annealing the cold or hot worked ingot at a temperature of 300 to 600°C for two minutes to five hours; and cooling the annealed ingot at a cooling rate of 0.2 to 10°C/sec. The method of Dong comprises the steps of: casting the raw materials of the copper-base alloy to form a billet; holding the billet at 800°C for 30 minutes; and then, hot extruding the billet into a bar. Thus, the method of Dong is quite different from a method for producing the claimed copper alloy, so that it cannot produce the claimed copper alloy.

Therefore, the method of Dong cannot produce any copper alloys having an excellent stress corrosion cracking resistant and an excellent dezincing resistance while maintaining excellent characteristics of conventional brasses, although it can produce copper-base alloys having a stable and excellent dezincing resistance.

Specifically, Dong discloses twenty samples of copper-base alloys (Sample Nos. 1-20). However, in the copper-base alloys disclosed as all sample Nos. 1-20, at least one of the contents of tin and silicon is beyond the ranges as claimed in claims 1 and 12 although both of the claimed contents are essential to copper alloys as claimed in claims 1 and 12.

Therefore, the copper-base alloys disclosed as all sample Nos. 1-20 are quite different from copper alloys as claimed in

claims 1 and 12.

Furthermore, the copper-base alloys disclosed as all examples, except for Samples Nos. 13 and 17, by Dong have a hardness of 105 to 165, which is beyond the range of 80.2 to 103.1 as claimed in claims 1 and 12. The copper-base alloy in Sample No. 13 has a hardness Hv of 102, and the copper-base alloy in Sample No. 17 has a hardness Hv of 98. Thus, the copper-base alloys disclosed as Samples Nos. 13 and 17 have the claimed hardness Hv of 80.2 to 103.1. However, the copper-base alloys disclosed as Samples Nos. 13 and 17 are quite different from copper alloys as claimed in claims 1 and 12 even if they have the claimed hardness, since they have different compositions from those of copper alloys as claimed in claims 1 and 12.

In addition, the copper-base alloys disclosed as all examples, except for Samples Nos. 7 and 15, by Dong do not have the claimed apparent content B' of zinc in the alloy. The apparent content B' of zinc in the copper-base alloy is 37.97 wt% in Sample No. 7 and 37.75 wt% in Sample No. 15. Thus, the copper-base alloys disclosed as Samples Nos. 7 and 15 have the claimed apparent content B' of zinc in the alloy (the apparent content B' of from 34 to 39 wt%). However, the copper-base alloys disclosed as Samples Nos. 7 and 15 are quite different from copper alloys as claimed in claims 1 and 12 even if they have the claimed apparent content B' of zinc in the alloy, since they have different compositions from those of copper alloys as claimed in claims 1 and 12, i.e., since at least one of the contents of tin and silicon in each of the copper alloys disclosed as Samples Nos. 7 and 15 is beyond the range as claimed in claims 1 and 12.

Thus, Dong fails to disclose or suggest any copper alloys consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5

wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities, the apparent content B' of zinc in the copper alloy being in the range of from 34 to 39 wt%, and the copper alloy having a hardness Hv of 80.2 to 103.1.

Furthermore, the apparent contents B' of zinc in the copper-base alloys disclosed as all examples, except for Samples 7 and 15, by Dong are 42.27 wt% (sample 1), 43.56 wt% (sample 2), 42.72 wt% (sample 3), 43.02 wt% (sample 4), 39.80 wt% (sample 5), 39.05 wt% (sample 6), 39.66 wt% (sample 8), 42.08 wt% (sample 9), 41.06 wt% (sample 10), 41.42 wt% (sample 11), 39.62 wt% (sample 12), 39.56 wt% (sample 13), 41.37 wt% (sample 14), 43.58 wt% (sample 16), 41.15 wt% (sample 17), 51.91 wt% (sample 18), 51.97 wt% (sample 19) and 50.25 wt% (sample 20), respectively, all of which are beyond the range of 34 to 39 wt% as claimed in claims 1 and 12.

As described above, Dong fails to disclose or suggest any copper alloys having the claimed composition (which is limited by the apparent content B' of zinc in the copper alloy) and having the claimed hardness. Therefore, Dong fails to disclose or suggest any copper alloys having an excellent stress corrosion cracking resistance and an excellent dezincing resistance while maintaining excellent characteristics of conventional brasses, even if copper-base alloys of Dong have a stable and excellent dezincing resistance.

Dong also fails to disclose or suggest any methods for producing the claimed copper alloys, comprising the steps of casting the raw materials of the alloy to form an ingot; hot

working said ingot; cold or hot working the hot worked ingot; annealing the cold or hot worked ingot at a temperature of 300 to 600°C for two minutes to five hours; and cooling the annealed ingot at a cooling rate of 0.2 to 10°C/sec. Therefore, Dong also fails to disclose or suggest any methods capable of producing copper alloys having the claimed composition and the claimed hardness.

Therefore, it would not have been obvious to one having ordinary skill in the art at the time the invention was made to make the present invention on the basis of the teaching of Dong.

Claims 12 and 13 were rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent 4,294,629 to Szyszkowski.

Szyszkowski discloses a brass essentially containing, in addition to copper, from 30 to 40 wt% of zinc and from 1.5 to 4.5 wt% of lead, up to 1.3 wt% of tin, and up to 0.01 wt% of silicon.

However, Szyszkowski fails to disclose or suggest any copper alloy containing 0.03 to 0.5 wt% of silicon. Szyszkowski also fails to disclose or suggest any copper alloy containing at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%.

Therefore, Szyszkowski fails to disclose or suggest any copper alloy consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities.

In addition, Szyszkowski fails to disclose or suggest any

copper alloy having the claimed hardness, i.e., a hardness Hv of 80.2 to 103.1.

Therefore, Szyszkowski fails to disclose or suggest any copper alloy having the claimed composition and the claimed hardness.

Moreover, Szyszkowski fails to disclose or suggest any copper alloy which has the claimed composition and wherein the apparent content B' of zinc in the copper alloy is in the range of from 34 to 39 wt%.

Thus, Szyszkowski fails to disclose or suggest any copper alloy having an excellent stress corrosion cracking resistance and an excellent dezincing resistance while maintaining excellent characteristics of conventional brasses.

Therefore, it would not have been obvious to one having ordinary skill in the art at the time the invention was made to make the present invention on the basis of the teaching of Szyszkowski.

Claims 12 and 13 were rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent 4,259,124 to Smith et al. in view of U.S. Patent 4,294,629 to Szyszkowski et al. or U.S. 2002/0015657 to Dong.

Smith discloses an alloy consisting essentially of 0.1 to 2.0% by weight tin, 0.1 to 2.0% by weight silicon, 20 to 34% by weight zinc, and the balance copper.

However, Smith fails to disclose or suggest any copper alloy containing at least one of 0.3 to 3.5 wt% of lead and .3 to 3.0 wt% of bismuth. Smith also fails to disclose or suggest any copper alloy containing at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%.

Therefore, Smith fails to disclose or suggest any copper

alloy consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities.

In addition, Smith fails to disclose or suggest any copper alloy having the claimed composition, i.e., a hardness Hv of 80.2 to 103.1.

Therefore, Smith fails to disclose or suggest any copper alloy having the claimed composition and the claimed hardness.

Moreover, Smith fails to disclose or suggest any copper alloy which has the claimed composition and wherein the apparent content B' of zinc in the copper alloy is in the range of from 34 to 39 wt%.

Thus, Smith fails to disclose or suggest any copper alloy having an excellent stress corrosion cracking resistance and an excellent dezincing resistance while maintaining excellent characteristics of conventional brasses.

Therefore, it would not have been obvious to one having ordinary skill in the art at the time the invention was made to make the present invention on the basis of the teaching of Smith in view of Szyszkowski or Dong.

Accordingly, it is believed that the amended claims patentably distinguish the invention from the prior art.

An earnest and thorough attempt has been made by the undersigned to resolve the outstanding issues in this case and place same in condition for allowance. If the Examiner has any questions or feels that a telephone or personal interview would be helpful in resolving any outstanding issues which remain in this application after consideration of this amendment, the

Examiner is courteously invited to telephone the undersigned and the same would be gratefully appreciated.

It is submitted that the claims as amended herein patentably define over the art relied on by the Examiner and early allowance of same is courteously solicited.

If any fees are required in connection with this case, it is respectfully requested that they be charged to Deposit Account No. 02-0184.

Respectfully submitted,

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